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15 November 1954

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PRIMARY CARCINOMA OF THE LIVER IN RATS

Dr. Eliane Le Breton of Villejuif, France, reported on her studies of cancer in rats at the Third International Congress of Nutrition at Amsterdam.

In preliminary investigations lasting over two and one-half years she has been able to feed Wistar rats on a diet on which none developed primary carcinoma of the liver in spite of the presence in the food of 0.6 parts per 1000 of butter yellow (p-dimethylaminoazobenzene).

She then modified the diet by lowering the choline-glyceride ratio, but without any other alteration. On the second diet 100 per cent of the rats developed liver carcinoma on the same dosage of butter yellow.

RECENT OUTBREAK OF KALA-AZAR IN EAST AFRICA

Dr. R. B. Heisch of the Division of Insectborne Diseases, Kenya, described a recent outbreak of kala-azar in East Africa at the last meeting of the Royal Society of Tropical Medicine and Hygiene, 21 October 1954. The outbreak, which was first recognized in October 1952, has included some three thousand cases with the greater number occurring in 1953. Some fifty new cases each month are still being found. The area affected is the Kitui District, south of the Mau Mau territory and at an elevation between 2000 and 2500 feet. Seventy per cent of the cases have been in males with the age group 4 - 18 predominating.

Clinically the disease is very characteristic but the epidemiology has proven extremely difficult to

elucidate. After two years' concentrated work by a team of scientists, the vector has not yet been discovered, and no reservoir hosts definitely proven. The investigations so far indicate that a new epidemic situation arose in the Kitui District of Kenya during which large numbers of people and particularly children contracted kala-azar. Most of the infections were probably acquired in the bush rather than in houses. There is evidence that a sand fly of termitaries, Phlebotomus (Sergentomyia) sp. nov., which is taxonomically outside of the major group of the subgenus, Phlebotomus, may be the vector of the outbreak and that gerbils and mongooses are involved as reservoirs.

Further details will be found in a forthcoming Technical Report CNRL-96-54.

SYMPOSIUM ON STORM SURGES

The disastrous inundation over the dikes of the Netherlands and of the east coast of England on January 31 and February 1 1953, emphasized the need for research on the mechanism of storm surges or "storm tides", i.e. meteorological oscillations of sea level which have a period of one or two days. Consequently, a symposium on storm surges highlighted a joint meeting of the International Association of Physical Oceanography together with the International Association of Meteorology at the 10th tri-annual assembly of the International Union of Geodesy and Geophysics at Rome, September 14 - 24 1954. The IAPO and the IAM are two of seven associations of IUGG, the other five covering the fields of geodesy, seismology, volcanology, terrestrial magnetism, and hydrology.

A. T. Doodson (Liverpool Observatory and Tidal Institute) keynoted the symposium and pointed out the need for improved dynamical theory. Empirical formulas utilizing the driving forces (barometric pressures which impart a normal stress on the ocean and wind which imparts a tangential stress) have met with only partial success. Especially important is the tendency of a body to oscillate with a natural period.

In an important paper, H. Charnock (British National Institute of Oceanography) reviewed the results

of recent attempts to measure the drag of the wind on the sea. Evidence so far available is so conflicting that at no wind speed is the drag known within a factor of two. Four methods can be used for measuring stress: (1) Direct measurement of the Reynolds stress either above or beneath the boundary. The method has been used successfully over land, but the instrumentation is difficult and no such measurements have been made over water. (2) Inferring stress from the vertical profile of the mean wind but this involves assumptions concerning turbulence theory. (3) Measurement of the water surface slope. (4) Calculations based on the deviation of the actual wind from the geostrophic wind.

A series of papers considered the theoretical response of the sea to driving forces which were assumed to be known. A general solution is out of reach and all that can be done is to consider special situations with varying claims to reality. All of these papers were based on linearized equations but J. C. Freeman (Texas A. and M.) pointed the way towards a non-linear solution. J. C. Schonfeld (Central Research Division of the Rijkswaterstaat, Netherlands) emphasized the superposition of surge on an already existing tide. H. B. Hachey (Canadian Joint Committee on Oceanography) reported on a remarkable observation of internal surges which preceded by two or three days the arrival of a heavy storm.

The symposium emphasized the deep breach between the empirical engineering approach and the study of physical processes which play a part in the complex problem of storm surges. However, for any given region, an empirical method guided by theory, such as the North Sea method described by Rossiter, can now give useful results.

PHOTOGRAPHIC EMULSION TECHNIQUES USED FOR STUDY OF DISTRIBUTION OF URANIUM AND THORIUM IN ROCK SECTIONS

Dr. E. Picciotto and his colleagues at the Inter-University Institute for Nuclear Studies at the University of Brussels are doing some extraordinarily interesting work on the distribution of uranium and thorium in nature utilizing a photographic emulsion technique. The technique has been made possible by the development of sensitive nuclear

emulsions by the Ilford Company of Great Britain. A variety of emulsions is now available:

- G-5 Electron sensitive (too sensitive for alpha tracks)
- C-2 Most convenient for alpha tracks
- E-1 Less sensitive, very fine grain
- D-1 Less sensitive, very fine grain

These emulsions are available in gel form and when heated to 40° - 50°C they melt into a liquid which can be poured over the specimen. The liquid emulsions are far superior to photographic plates for the study of thin sections for the reason that the common photographic plate difficulties (air spaces and irregularities) are eliminated. The emulsions contain approximately 10 per cent gelatin and 90 per cent silver bromide.

Picciotto's technique for the determination of the distribution of radioactivity in a granite is as follows:

A thin section of the granite is prepared in the conventional way using Canada balsam. The thin section must be at least alpha-range thick, otherwise calculations cannot be made. A good thin section from the mineralogical point of view (35 μ) is too thin for this purpose. A sufficient quantity of liquid emulsion is next poured over the thin section to result in a final coating (after drying) of 60 - 70 μ . The thin section with the coating is dried in a box containing calcium chloride. Utilizing this technique, Picciotto obtains a yield of approximately 50 per cent (one-half of the plates formed in this manner are unsatisfactory because of air bubbles, stripping of the emulsion, chemical fogging or precipitation of silver). The thin sections are placed in a light-tight box containing calcium chloride and are exposed for periods ranging from one week to 50 days, depending upon the activity of the rock.

In a thick source containing one part-per-million uranium, one obtains one alpha per square centimeter per hour. Using a microscope magnification of 400, one has 0.02 alphas per field of microscope per day, or one must expose for 50 days to give one alpha per field. Fifty days is about the maximum exposure that should be used.

In utilizing this technique, developing is all important and a neutral developer should be used (pH, approximately 7). Picciotto uses a developer containing amydol. In order to obtain uniform development throughout the emulsion, the Occialini technique of immersing the plate in very cold developer and then raising the temperature is used.

Using this technique, a wide variety of studies has been made of the localization of radioactive elements in igneous rocks and in deep sea sediments.

It is interesting that the G-5 emulsion is being successfully applied at the University of Brussels for the localization of Carbon¹⁴ in biological tissue. (Item contributed by Prof. Harrison Brown, of the California Institute of Technology.)

MOTIONS IN THE EARTH'S CORE

In conjunction with the meetings of the International Union of Geodesy and Geophysics in Rome, a symposium was held under the chairmanship of Sir Edward Bullard (National Physical Laboratory, Teddington) on motions in the earth's core and the origin of the earth's magnetic field. There seems to be fairly general agreement along the lines of the Bullard-Elsasser dynamo theory, but not without opposition from W. H. Ramsey (Manchester) and a few others. The time scale of magnetic variations is intermediate between those typical of geologic events, and of atmospheric storms; it can be accounted for by the relative importance of electromagnetic forces on the "weather" in the fluid core. Turbulence in the core varies its angular momentum as a whole, and in the absence of outside torques, the angular momentum of the mantle must vary in an opposite way. Here it is possible to compare measurements at magnetic observatories with those at astronomical observatories. This problem was discussed by S. K. Runcorn (UCLA and Cambridge), E. H. Vestine (Washington), and R. Revelle and W. H. Munk (La Jolla, California). Price (Exeter) reported that on theoretical grounds one should expect a phase difference between the magnetically and astronomically observed quantities. H. C. Urey (Chicago)

pointed out that the energy for turbulence in the core cannot be provided by the original radio-activity of the iron phase in an accumulating earth, but that progressive solidification of the inner core is a possible source. J. Coulomb (Paris) considered the type of motion required to produce some of the observed secular variation in the magnetic field, and discussed in detail a divergent motion extending 50 km into the core, with upward velocities up to 5 m/sec. There are similarities here with the sun-spot problems. All these discussions presume the existence of a fluid core. There is also fairly general agreement concerning an inner solid core, the existence of which would affect the nature of the convective motion in the fluid core. A discussion by K. F. Bullen (Sydney) of the numerical values of density, incompressibility, pressure and rigidity as functions of depth served to emphasize how far our knowledge has advanced regarding the internal constitution of the earth.

It was felt by some that this colloquium on motions in the fluid core was premature; nevertheless, it showed clearly the usefulness of magnetic observations as a means of studying the interior of the earth and it suggests that improved magnetic measurements at sea are needed for further progress. (Item contributed by Dr. W. H. Munk, Scripps Institution of Oceanography.)

TENTH GENERAL CONFERENCE ON WEIGHTS AND MEASURES

The Tenth General Conference on Weights and Measures took place in Paris recently and considered a number of important new definitions and standards; Dr. A. V. Astin, Director of the National Bureau of Standards was the chief American delegate. Some of the most interesting matters discussed pertained to the definition of the thermodynamic temperature scale and to the definition of the standard unit of length and these are briefly discussed below.

The Thermodynamic Temperature Scale

At its meeting in July the Advisory Committee on Thermometry and Calorimetry of the International

Committee on Weights and Measures adopted the so-called Giauque-Kelvin proposal for a thermodynamic temperature scale based on one fundamental fixed point, the triple point of water. This point was defined as 273.16°K which was considered to be the best available value. This recommendation was accepted by the International Committee on Weights and Measures and was thereupon adopted by the General Conference. This new scale represents a considerable simplification in that it abandons the use of the boiling point of water which was difficult to realize experimentally, as a fixed point of the scale.

The Standard Unit of Length

As is well known, the accuracy of the standard meter has been considered inadequate for the past 25 years and a number of proposals have been made since then concerning an improved standard. The last (Ninth) General Conference urged the different national laboratories to make specific proposals and several of these were considered at the meeting. It is agreed that the standard unit of length will have to be defined in terms of the wavelength of the most suitable atomic transition of an isotopically pure element. The chief contenders are mercury, investigated principally at the National Bureau of Standards, Washington, cadmium, proposed by Soviet Russia, and xenon and krypton, both of which are being studied in Western Germany. Since no definite choice could be made among these, it was decided to postpone the decision until the next General Conference to be held in 1960.

NONLINEAR CONTROL PROBLEMS

A Seminar on Nonlinear Automatic Control Problems was held at the University of Cambridge, 22 - 25 September 1954, organized by J. F. Coales of the Engineering Department.

The completely general problem is intractable, and so it is important to specialize it with the hope that at least some of the methods used in linear problems

can be partially salvaged or extended. This was the theme of several of the speakers, who dealt with the system consisting of controller, motor, and load in the forward path with simple unity negative feedback, only one of these elements, usually the motor, being taken as nonlinear.

If the nonlinearity precedes the load, which functions as a low-pass device, it is possible to use the "describing function" method, which is an extension of the classical frequency analysis. This was treated by Mr. P. E. W. Grensted (Cambridge). Another approach depends upon replacing the nonlinear characteristic by an approximate piecewise linearized one. This was discussed by Mr. R. H. Macmillan (Cambridge). These are both approximate methods. For second-order systems, the well-known phase-plane method is available. Dr. G. D. S. MacLellan (Cambridge) discussed this, paying particular attention to the influence of such typical nonlinearities as saturation, dead-time, and hysteresis upon the shape of the trajectories. Finally, Prof. Hartree (Cambridge) gave an example of a system which was not amenable to describing function or piecewise linearization methods, but which could be treated readily by classical numerical integration.

The classification of systems was considered by Dr. E. C. Cherry (London), who suggested two possible approaches. One depends upon the characterization of the system elements and the inputs as determinate or stochastic. The other is made in terms descriptive of the over-all system characteristics (e.g. learning system, anticipatory system, trial-and-error system, etc.). It was urged that much could be learned from a study of economic and biological systems.

The question of system stability was discussed, chiefly by Grensted. He reviewed various possible criteria, and concluded that the most natural quantity to use as a criterion is the total stored energy.

Finally, nonlinear systems with random inputs were discussed by Coales, who reviewed methods proposed by E. G. C. Burt (Royal Aircraft Establishment) and R. C. Booton (Massachusetts Institute of Technology).

The first was shown to be analogous to the describing function method, while the latter depends upon replacing the nonlinearity by a certain best linear approximation. He then outlined a method of determining the stability of a second-order system subject to random inputs by considering the random motion of the representative point from trajectory to trajectory in the phase-plane.

A fuller account of the Seminar will be contained in Technical Report ONRL-98-54, and Dr. Coales also plans to publish the Proceedings of the Seminar.

STRENGTH OF FERMI INTERACTION IN BETA DECAY

It has been known for several years, from the work of Sherr on O^{14} and Cl^{36} , that allowed Beta-ray transitions occur in which the initial and final nuclei both have zero spin ($0 \rightarrow 0$ transitions). The nucleon-electron-neutrino interaction responsible for beta-decay can, on quite general grounds of relativistic invariance, be of only two possible classes, the so-called Fermi and Gamow-Teller interactions. The selection rules for these interactions are quite different, only the Fermi interaction giving allowed transitions of the $0 \rightarrow 0$ type. Thus the existence of these transitions shows the presence of a Fermi-type interaction, in addition to the long-known Gamow-Teller interaction.

The strength of the interaction, which should be the same in all nuclei, is measured by the comparative half-life of $0 \rightarrow 0$ transitions. Drs. P. M. Endt and J. C. Kluyver (Utrecht) have recently been working on Al^{26} . They find for the comparative half-life of the 6.6-second excited state, which decays by a $0 \rightarrow 0$ transition, the value $ft = 3200 \pm 80$ sec. This is to be compared with 3275 ± 75 for O^{14} and 3210 ± 50 for Cl^{34} . These concordant results establish clearly the strength of the Fermi part of the interaction. It is notable that the strength of the Fermi interaction in beta-decay is now better known than the long-known and more frequently investigated Gamow-Teller interaction.

ONR - CERN COSMIC-RAY FLIGHTS

A unique venture in international cooperation on cosmic-ray experiments is under way. It consists of the joint sponsorship of balloon flights by ONR and CERN, the European Council for Nuclear Research, which maintains a cosmic-ray information exchange under Dr. Yves Goldschmidt-Clermont. CERN has previously organized balloon flights from Sardinia in which many European laboratories participated.

ONR is planning a series of "Skyhook" high-altitude balloon flights in Texas in January 1955. In connection with the flights, in which primary loads will be carried aloft for ONR contractors, it turned out to be possible to take along some additional loads for European scientists on a "hitch-hike" basis. Through the ONR Branch Office in London, ONR and CERN have now jointly issued invitations to interested European laboratories to participate in the Texas flights, and will assist in making the necessary arrangements.

PSYCHOLOGICAL EFFECTS OF OLD AGE

At the meetings of the Third Congress of the International Association of Gerontology held in London, 19 - 23 July, H. E. Jones (University of California) reviewed earlier studies and presented additional results bearing on the problem of change in intelligence with age. He concluded that there is a decline in intelligence, as measured by the standard intelligence tests, with age and that the decline cannot be accounted for in terms of sampling error, decrease in speed of performance or deficit in sensory capacities.

J. E. Birren (United States Public Health Institute) presented evidence from both neurophysiological and psychomotor studies. On the basis of the evidence he concluded that the slowing up of simple behavioral responses and of perception with age cannot be accounted for by changes in velocity of nerve conduction or slowing up of effector processes. It would appear that changes in

perceptual and central integrative processes are more important.

Harry Kay (Oxford University) described experiments in which subjects ranging in age from 15 to 72 were tested in a learning situation. He found that on very simple learning problems older subjects make no more errors than younger but as the complexity of the problem increases the older subjects become increasingly poorer. Part, at least, of the difficulty, Kay believes, is due to the inflexibility of the older subjects; they continue to try wrong solutions to problems.

NEW JOURNALS

Technical Book Review

The first issue of a valuable new journal entitled "Technical Book Review" has recently appeared in London. The sole object of this journal will be to review scientific and technical books covering a wide range of subjects in science, engineering, medicine, and technology. This wide coverage is an act of deliberate policy in the hope that it will enable workers in these different fields to become aware of new books of interest to them even when they deal with apparently unrelated subjects.

Each issue of the journal will fall roughly into two parts, the main part being reviews of new books and the second being a classified list of books recently published or about to be published in the United Kingdom, the British Commonwealth, and the United States of America. It is intended to include books in foreign languages in this section at a later date.

"Technical Book Review", published by E. W. Publications Ltd., 23 Golden Square, London, W.1, is to appear in alternate months and the annual subscription is 15 shillings.

Deep-Sea Research

"Deep-Sea Research", an international journal, is sponsored by the International Commission on Oceano-

graphy of the International Council of Scientific Unions. It stresses the processes important to the deep-sea bottom and the organisms dwelling in the bathyl environment. An understanding of these may depend on processes only indirectly related to the deep-sea floor. The editors, therefore, encourage the submission of papers on quite diverse subjects. The journal is published as a quarterly, the first number of the second volume has just appeared.

The subscription price for libraries, research departments, government offices, industrial firms, etc. is \$12.60 per volume (four numbers). A reduced subscription price for individual subscribers using the journal for their own private use of \$9.80 will be introduced in January 1955. The journal can be purchased through the publishers, Pergamon Press Ltd., 242 Marylebone Road, London, N.W.1.

The editors are L. Fage of Paris, C. D. Ovey of Cambridge, and Mary Sears of Woods Hole. The editorial advisory board consists of 15 members including Roger Revelle, Maurice Ewing, and Harold C. Urey from the United States.

PERSONAL NEWS ITEMS

Professor H. Bethe, of Cornell University, has accepted an invitation to work in the Cavendish Laboratory, Cambridge University, during 1955-6. The invitation was made after the General Board had approved a suggestion by Professor Mott, who has succeeded Sir Laurence Bragg as Cavendish professor of experimental physics, that he should have the help, for about a year, of a scholar of outstanding distinction in nuclear physics to advise on the laboratory's development in that field. (The Manchester Guardian, 26 October 1954)

Dr. Maurice Lévy, who is well known to American physicists from his visits to the United States and for his important contributions to meson theory, has been elected Professor of Theoretical Physics at the Ecole Normale Supérieure of the University of Paris. He is believed to be the youngest man ever elected to this post.

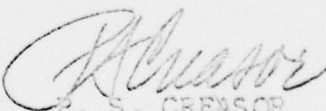
Dr. E. Wicke of Göttingen has accepted the invitation to the chair of Physical Chemistry at Hamburg, as the successor of Professor P. Harteck (at present at Rensselaer Polytechnic Institute, Troy, New York).

TECHNICAL REPORTS OF ONRL

The following reports have been forwarded to ONR, Washington. Copies may be obtained by addressing requests to the Commanding Officer, Office of Naval Research Branch Office, Navy No. 100, c/o Fleet Post Office, New York, N.Y.

- ONRL-80-54 "International Conference on Defects in Crystalline Solids" by W. N. Arnquist and L. Himmel
- ONRL-84-54 "International Conference on Semiconductors" by W. N. Arnquist
- ONRL-90-54 "Large External Beam of 400 Mev Protons" by J. R. Richardson
- ONRL-91-54 "The Welsh Marine Biology Station, Menai Bridge, Anglesey, Wales" by T. K. Ruebush
- ONRL-93-54 "Studies of the Auditory System, Current Research of Laboratories in Sweden, Norway and Switzerland" by W. D. Neff
- ONRL-95-54 "Research in the Departments of Psychology and Education at the University of Uppsala, Sweden" by W. D. Neff

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